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ABSTRACT

Changes brought about in higher education by the information-oriented society and the influence of the marketplace on the university's products are analyzed. The role that education played in the industrial revolution is also addressed. It is claimed that education adopted the goals of industrialization and, in its educational philosophy, structure, and content, attempted to produce the product demanded by the marketplace. Similar trends are noted for the information era, but with some important differences: the growing importance of information as an economic good in its own right and the changes in market demand for worker skills. It is suggested that since the industrial revolution, the university has provided three major types of products for society: an educated and socialized worker, knowledge in the form of basic research, and knowledge in the form of applied research. The university's role in providing continuing education and industry's involvement in employee development and training are also considered. Finally, attention is directed to competition from industry for academic personnel and the potential for continued basic and applied research at the university. (SW)

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THE ROLE OF EDUCATION IN THE INFORMATION SOCIETY

by
Dr. Sharon Strover and Dr. Mark T. Bryant

As we scrutinize the changes accompanying what we call the "information society," questions logically arise concerning how different, how revolutionary these events or processes really are. How do they compare in significance to those associated with the last great technological revolution, the "industrial revolution?" Certainly during the industrial revolution the nature of work changed drastically with the introduction of new types of machines. New distribution systems developed around the framework of the mass production assembly plant and the railroad, and different types of workers were needed for the increasingly compartmentalized, bureaucratized and hierarchical production systems.

So, too, we now see at least these same three changes. Work is changing with the introduction of new information machines, particularly computer-based machines. VDT's alter news writing and production tasks, and computers have created entirely new methods by which to manage people and processes. People routinely interact with electronic machines where five years earlier they would have interacted directly with an individual. Distribution systems for various products have mushroomed with the availability of information technologies that allow information to be stored and accessed easily. The compilation of databases accessible to both layperson and specialist facilitate this distribution network. Television-based training and

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education are commonplace where once education was distributed only in one's physical presence. Electronic funds transfer and electronic mail are replacing the Post Office and Brink's in the distribution of capital. The computer and the telecommunications facilities which serve it have taken the place of the plant and the railroad as the symbol of the times. Finally, the labor force most in demand is one in possession of certain technical skills, particularly those related to computer software and hardware, as well as analytical and managerial skills. Different types of workers seem necessary now.

In the industrialization era just as today, society has looked to higher education as the supplier of what the economic market requires -- an educated workforce, a socialized labor pool, and trained innovators, among other things. With increasing awareness of the importance of certain technological innovations to the economy, both in terms of efficiency and in terms of new products, the function of the university now appears in high relief. As this country's competitive edge in the world marketplace diminishes, the agencies that can maintain our economic lead, become targets of government and industry concern. The educational system is one such critical agency. Just as when the Soviet launch of Sputnik catapulted concern for the nation's scientific and math education programs, so too we now see concern for education's efficacy in areas such as computer science, math, and even basic literacy.

We do not propose that the information society radically

transforms the pressures and structures of the educational system providing the labor and innovations to feed technological progress: rather, this paper argues that the trends fitting the educational system to the market have been in place for decades. The speed and muscle that now pressure educational changes may, however be sufficient to prompt a conscious refocusing of educational philosophy and to relocate higher education's role as a key supplier in the information economy.

The Relationship of Education to Industrialization

The relationship of the educational system to what the economy demands traditionally has been one of slave to master. The earliest schools served sectarian interests by producing learned clergy who could record and translate scripture and perhaps keep track of the pastoral holdings. The development of educational systems in this country is the product of constant dialogue between representatives of society (e.g. the legislature), of business, and the educators themselves. In an sense, education has always been viewed as an input or a supply to the social market. Its role in a time of great social and economic change, the industrial revolution, was one not only of providing a worker possessing standard language or mechanical skills but also of providing a worker possessing the proper social attitudes and expectations. So, for example, one early U.S. Commissioner of Education stated that school provided people with training in those habits of regularity, silence and industry which would

preserve the civil order (Edwards and Richey, 1947).

Education and the greater accessibility to knowledge that it offers were the foundations of the later 19th century liberal reform movement personified by people such as William James, William Kirkpatrick, and John Dewey. In that movement, education was thought to 1) integrate youth into job, social and other roles required by the economy and American society: 2) provide opportunities for social mobility or class restructuring: and 3) promote the psychological, ethical and moral development of individuals.

An alternative, more pragmatic interpretation of the role of education also from that era casts it more prominently as an input to the process of industrial development: "Because modern industry consists in the application of increasingly complex and intellectually demanding production technologies, the development of the economy requires increasing mental skills on the part of the labor force as a whole. Formal education, by extending to the masses what has been throughout human history the privilege of the few, opens the upper levels in the job hierarchy to all with ability and willingness to attain such skills" (Bowles and Gintis, 1976). Within this theory, because the educational system is open to all and inculcates the competitive spirit necessary to separate those with the drive to succeed from those without it, education works in tandem with the economic system to produce those personalities and talents most suited to the socially desirable worker and citizen. The liberal reformers'

version of education's function as a supplier to society and the economy then was a slightly more altruistic conception than the latter philosophy which acknowledged education's class restructuring potentials but not its other ethical and role-training importance.

Basic to both ideas, however, is the notion that education serves an economic purpose and that it has the potential of offering social mobility: people can use education to claw their way to the top, to realize that Horatio Alger dream of "making it." Education is thus the keystone to a philosophy that embraces individualism and self-development. According to this ideology, socially-supported education is integral to the American dream, providing everyone with at least the tools to succeed.

What role did education play in the industrial revolution? What were the demands of the industrial era on education? Edwards and Richey (1947) comment that no clear pattern emerged with respect to the skills required of workers under the brunt of technological change in the first thirty years of this century. While each year the proportion of unskilled workers in the nation's labor force shrank, no opposite increase in the proportion of skilled workers occurred. It seemed that in some industries the semi-skilled workers were becoming more numerous. They concluded that skilled and semi-skilled workers increased at the expense of the unskilled. One government report noted that there seemed to be a "leveling of skills" required in mass

production industries (Koepke, 1939). Indeed, it is only logical that the division of labor multiplied the types of occupations available, while at the same time it limited the quantity of skills any one job required. Hence, the proliferation of a "semi-skilled" job category. This supports the notion that more education might be required in order for one to advance during the period of industrialization.

Ironically, however, the overall intellectual demands of the industrial era shrank. One critic asserts that the industrial revolution produced a need for quantities of unskilled laborers. In fact, machinery was designed to reduce the skill and intelligence needed to operate it. The efficiencies and time-saving it offered workers were not benefits they were to realize; rather, employers used the machinery to justify ever longer work shifts and wage reductions. Skilled workers became not the masters of such machines, intimately acquainted with their operations and maintenance, but rather technicians or supervisors, positions in which their actual skills were irrelevant. Alternatively, skilled workers occupied small pockets in industries where mechanization would be slow; the printing profession is an example of this. There, very highly developed technical skills that were not able to be machine-duplicated buffered workers from the displacements and poor working conditions common to mass production industries.

It is probably accurate to characterize the net effect of industrialization as one which shifted the overall skill level of

workers slightly upwards, but which made no difference in terms of the worker's wage or relationship to his or her work. No additional job mobility was gained through the acquisition of the limited skills needed to operate a piece of machinery -- certainly nothing comparable to the skill required to be a woodworker or printer of the old school. Hence, the effect of industrialization may have been to place more workers in the "semi-skilled" job categories; but with the entire labor distribution shifting upwards, no structural changes are implied.

Yet, across the industrial era -- from 1860 to the 1940's -- educational systems multiplied, enrollments increased, the quantity of teachers escalated and the types of subjects taught also proliferated. If the actual educational needs of the labor force were not the prime motivator for such an expansion, what else contributed to it? We must look elsewhere for the industrial society's needs for an educated populace. The inculcation of a democratic and capitalist ideal through the vehicle of education provides one answer. Short of redistributing society's wealth, the educational system at least holds out a promise of a better life ahead. It molds one's morality and values to the advantage of all, the "all" being the stratified society in which schooling operates. "Much of the content of education over the past century and a half can only be construed as an unvarnished attempt to persuade the 'many' to make the best of the inevitable," the inevitable being the maintenance of the existing class structure (Bowles and Gintis, 1976). We are schooled in obedience to social control, a

precursor to organizational hierarchies and the descending power ladder still typical of industry and corporations today.

The explanatory power of the careful feeding and watering of a belief in the values of this economic system, a growth process spanning several years, may be significant. One historian comments, "It was no longer enough for the schools and colleges to concern themselves primarily with passing on the cultural heritage as it had been traditionally thought of; they now had the additional responsibility of preparing youth for and guiding them into vocational life with its constantly increasing number of new occupations, its vast accumulation of new skills, and its instability of job opportunity. But, education for efficient production was not the only new demand society was making on the schools: education had to prepare citizens for intelligent consumption and for a wholesome use of leisure time" (Edwards and Richey, 1947). It may not be so much an educated workforce that is essential for the economy as is one that is well socialized.

How did the needs of the industrial society become translated into actual educational programs? Untangling the close link between state and industrial mandates over the course of higher education's history is beyond the scope of this examination. Yet, the dicta of the marketplace are illustrated by such legislative acts as the Morrill Land Grant Act of 1862, which established land grant colleges in 48 states, two territories and Puerto Rico, and the Smith-Hughes Act (1917) which fostered vocational education. The former supported the founding of

colleges where "without excluding other classical and scientific studies, and including military training, the leading object shall be" to teach agriculture and mechanics and prepare "for the ordinary pursuits and professional in life." Pressure to create centers of higher learning which could cater to the specific needs of agriculture and industries without the distractions of liberal studies resulted in the land grant college systems (Chambers, 1968).

An examination of the vocational education movement and its utility for industry is illustrative. Before the 1890's, worker's skills were passed on from worker to worker; the inculcation of a skill or craft was based on the relationships maintained by the people in possession of those skills. The vocational education movement of the late 19th century, however, gained the backing of leading capitalists (J.P. Morgan, Rockefeller), and effectively created a mechanism whereby those skills would be developed and certified by an agency outside the workers' control. Vocational education represented a threat to organized labor and to the remnants of the apprenticeship program, who felt vocational schools were "breeding grounds for scabs" (Bowles and Gintis, 1974).

Yet, the tide was not to be stemmed: by 1917 the federal government was pushing vocational education and willing to fund it as well (via the Smith-Hughes Act). Organized labor eventually joined the movement if only to have some control over this threat. The viability of the vocational school as a siphon

for working class, immigrant, and minority children should not be overlooked either. Vocational schools represented a way of funnelling that was for a more elite youth. The fact that in some states, huge percentages of the minority population now attend community colleges -- often times the modern day equivalent of the vocational school -- suggests the same is true today. For example, in California 60% of all Chicanos attending college begin in a community college. Thus, this legislation codified a system of vocational education no longer based on the workers themselves. The educational site was to be the "independent" training ground. Pragmatically speaking, it has always been common for vocational programs to work with the controllers of business and industry rather than with the representatives of the workers themselves. Vocational internship programs and the like typically work through an organization's personnel department in placing students. Removing the responsibility of training from the laborer and placing it in the hands of "society" offered a way organizations could gain new leverage over the educational input to their own market.

Curriculum changes also demarcate education's adaptation to the needs of industrialization. A few types of labor that nourished the efficient operation of early 20th century industries rested on the acquisition of fairly specialized knowledge. Such knowledge concerned the application of social science -- sociologists, economists, psychologists, political scientists -- to the problems of human behavior with which industrialism had to contend. As the problems of industrial

organization and social policy became more complex and greater in scale, new management and motivation techniques were required. This was all in keeping with the "scientific management" theories so in vogue.

Domhoff (1978) points to the overt involvement of industrial organizations in the formulation of educational policy. In 1949, the Joint Council for Economic Education was formed by the Committee for Economic Development under funding from the Ford Foundation, and later from corporations and corporate foundations for the purpose of influencing public schools in the teaching of economics. The program has included the publication of curriculum guides, textbooks, and pamphlets, and has extended to the creation of Centers for Economic Education in universities and colleges, in a largely successful attempt to institute requirements for coursework in economics as a part of teacher traning programs.

Social technology, the logical extension of the industrialization ethos into human relationships, emerged as a curriculum idea for high schools and colleges. "It was essential...that the old concept of the high school as an institution primarily concerned with providing intellectual discipline and college preparation for a select body of youth be abandoned or fundamentally modified. The new goals of secondary education, forced upon it by the impact of social change, were social-civic competency, healthful living, constructive use of leisure time, and occupational efficiency" (Edwards and Richey,

1947, p. 741). Underscoring this is the finding by Loomis, et al (1933) that the greatest increase in high school subjects across 1906 to 1930 was in the fine arts, commercial studies, social studies and English.

The importance of these subjects to the skill levels and social integration of the working class is apparent. The emergence of household arts is a particularly telling sign; the new class of women were to be efficient housekeepers and consumers, schooled in the best ways of running households and of purchasing goods. The core curriculum in higher education in the mid-19th century -- philosophy, ancient languages and math -- gave way to sciences, social sciences and modern languages in the 20th century.

Hence we see in this brief history that education adopted the goals of industrialization, and in its philosophy, structure and content attempted to produce the product demanded by the marketplace. The industrialization era interacted with an educational system so as to produce individuals possessing some reliable standard of language proficiency (important with an immigrant population) and some types of skills. It produced a citizenry schooled in believing education's value for getting ahead, motivated to succeed in society's terms, and socialized in the ethos of individualism. The educational system inculcated standards of consumption and leisure time use for its students, thereby extending the industrial ethic beyond the plant and into the home. Curriculum introduced subjects appropriate to

industrial processes, those social technology areas mentioned above.

Education always imparted an information product to the economy. During the industrial era, that product was primarily the individual. Over time, the university also produced usable knowledge. Growing emphasis on science, technology and social science -- areas with commercial application -- spawned more basic research, and led to university involvement in applied research. The industrial era highlights some of the ways in which the university functions to support the economy.

In the information era, we see the same trends, but with some important differences. The growing importance of information as an economic good in its own right and the changes in market demand for worker skills may force fundamental changes in the relationship between the university and the markets with which it is engaged. The basis of the economy rests on even more highly trained workers, and on the way in which information technology adds to the packaging of commodities. As in the industrial era, increased skill levels will probably not lead to class restructuring: the types of jobs requiring "new" skills -- word processing is a good example -- will simply shift to the bottom of the status pile. Curriculum is altering to produce needed engineers and computer scientists; research priorities are moving toward fundable areas, which again are in part determined by economic needs. Such changes do not occur without rebound effects on some other university services.

As the links between the educational system and the marketplace tighten, the university is drawn into the same competitive spirit that characterizes the American system. Its products must compete, its structure must facilitate that competitive end, and its non-market related outputs face a colder-than-ever environment.

The University as Supplier in the Information Society

One can say that since the industrial revolution, the university has provided three major types of products for society: an educated and socialized worker, knowledge in the form of basic research, and knowledge in the form of applied research. Each product constitutes an input increasingly important in an information society, as well as one endowed with historical significance.

In the tradition of early 20th century thought, the education of men and women to assume positions of responsibility in business, industry, education, applied science and technology and in the humanities became a major focus of undergraduate education. Eschewing the term "training," the rhetoric of educational institutions emphasizes education and knowledge rather than the provision of skills.

Another way in which the university has endeavored to produce the useful worker and citizen has been through providing continuing and professional education to those who have completed

studies at the university or those who are prevented for pursuing a full-time university education. This is a relatively new audience for the services of the university, but one being avidly developed by schools that face shrinking undergraduate enrollments from their traditional pool of graduating high school seniors.

Training at the graduate level in science and the humanities has been another function of the university. In reproducing itself, creating the future academics and professors and university-based researchers, higher education maintains the academic enterprise, replacing worn-out "parts," expanding some divisions, and shrinking others. In a sense, the academic factory is like all others: a constant supply of labor must come from somewhere. The university educates and socializes its own workers.

Hence, the educational cultivation of the individual molds the "knowledgeable" and responsible and well-socialized person; the part-time or off-campus nontraditional student; and the advanced specialist who has received graduate training and works within higher education.

The second major output of the university is the provision of new information and knowledge. The university has been seen as a place where disinterested inquiry may be pursued for the advancement of knowledge benefitting all of civilization. The academy has vigorously defended the prerogatives of academic freedom, and elaborate safeguards have evolved to ensure that the

pursuit of knowledge will not be constrained by external political or economic influence. Of course in all practicality, the research enterprise within the university is frequently funded by outside sources, be they private or federal or state government, and such funders frequently have information requirements they hope will be satisfied by such research. Moreover, basic research, in their eyes, may have immediate economic or political utility. Hence, its support has been seen to be a wise investment. The extent to which the direction of basic research is dictated by its subsidizers is considerable (Gandy, 1983).

In addition to basic research, the university increasingly provides applied research. This input to the economy is structured so as to be immediately usable. Its utility within the university varies: it can support graduate assistants; it can support faculty who also perform other research and teaching functions; its content can be combined with basic research inquiries; it can provide needed funds to the school for entirely different purposes. Additionally, it provides "service" to the community. For example, applied research often informs various policy debates. Recent arguments over children and television advertising, children and violence on TV, the contribution of television to economic and educational well-being in other countries are examples. The politician who espouses an economic or social policy without scientific support for his or her views is rare, and it is common practice to obtain the services of academic experts either in the form of consultation or in the

appointment of "expert" panels when policy alternatives seem unclear, or when political resolution is difficult.

In one way or another, each of these major functions has evolved over the past century. The university has developed a generally comfortable position with respect to economic demands, adjusting its values, structures and products as society's needs -- the needs of the marketplace -- change. New information technologies and the increasing economic emphasis on the production and distribution of information, however, portend changes in the educational system that may have consequences even more far-reaching than curriculum and research changes observed during the industrial era. Let us consider each of the university's major products and their future in the information society.

Producing the Educated Worker and Citizen

Universities are increasingly faced with a student population that must be attracted to their specific type or style of education. It is remarkable that several schools are scrambling to recruit undergraduates with outstanding academic abilities, as has been the tradition in college sports with respect to athletic abilities. The maintenance of a certain caliber undergraduate population translates not only into academic distinction for the institution, but also into continued support from the private and government sources that see their future labor pool emerging from that institution. In competing with other universities for the

student qua commodity, the university is simply attempting to maximize the return on its investment; its students enter the work force, establish links to productive entities, which in turn reinvest in what (hopefully) proves to be a fertile breeding ground for the next generation of workers. Such competition for students is a direct product of an economy that values certain skills or predispositions in students.

Moreover, the student population itself exerts strong influence on the university's internal allocation of resources. Computer science and engineering departments are finding themselves over-enrolled as students perceive that high-paying jobs are to be had in those fields. This creates pressures for allocating faculty, space, facilities and other resources to those areas. Faced with finite budgets, such resource reallocations can only mean one thing: programs in other areas will suffer. Their subsidy shrinks as the educational institution evaluates the knowledge they provide as being somehow less useful, rational, or important.

Thus the student as an information product, as the embodiment of the university's knowledge, is becoming a more narrowly defined entity from the recruitment and selection point of view, and one that increasingly ties the university to its industrial base. This process would occur no matter what the nature of the industrial or economic change. However, when one is dealing with the production of the knowledgeable individual, one must wonder about the quality of a product so shaped and constrained in its

formative stages.

Producing Continuing Education

Information technology advances have made the private production of information as education feasible. The private information production sector, unlike the university, is not bound by the kind of institutional inertia which makes it difficult for the university to respond to changes in market structure or demand. It does not have to negotiate legislative acts which create special information products, as was the case with the land-grant colleges and vocational education. The largest, most lucrative areas of the educational market may be very quickly exploited by the private producer, with educational products enjoying almost instantaneous distribution to a nationwide audience. While most of the educational production entities have focused thus far on the continuing education market, undergraduate education too is not immune from competition from non-university based providers.

For example, according to Leddy (198) the Appalachian Community Service Network (ACSN) was developed as a project to bring continuing education to teachers in isolated areas of Appalachia. It then expanded its program offerings to include a variety of continuing education and community education telecourses. While ACSN itself does not grant credit for successful completion of course work via satellite, it facilitates obtaining credit through local colleges and

universities. AETN, the American Educational Television Network, was formed as a for-profit venture, the purpose of which was to tap the large market of professionals who require continuing education units (CEUs) for certification in their occupations. Nearly every state requires continuing education in professions such as optometry, nursing home administration, and secondary education, and a majority require continuing education of accountants, doctors, nurses, and veterinarians. To the extent that professionals in these occupations may satisfy continuing education requirements more easily via cable television, AETN may represent a competitive challenge to those universities which offer such courses.

The Public Broadcasting System (1981) has established an Adult Learning Department (PTV-3) which has as its purpose the development and distribution of courses in three areas: 1) college credit courses; 2) informal learning courses and programs; and 3) professional development and career training courses and programs. The courses are designed for credit offerings through a local participating academic institution.

Undoubtedly the most significant challenge to the university's role in providing continuing education is industry's own involvement in internal employee development and training. The vocational school of the 1980's may be industry itself. One set of recent statistics indicates industry outspends universities in this country in training and education: $60 billion is invested yearly on behalf of industry, compared to $50 billion on behalf

of universities (Shair, 1982). It is more and more common for industries to sponsor in-house training, to support large staffs for employee development and to invest in continuing education programs they can control. Obviously they have not eliminated the universities from this process. Rather, they buy professors and researchers as "consultants" or "trainers" and ship them into the company setting where they are well paid for transmitting their information and knowledge. This practice represents industry's most complete control over the process of educating its workforce. Institutions of higher education have been loathe to discourage this, lest they alienate their faculty, which benefits financially from this arrangement.

Another indication of the growth in the private production of education is the increasing use of inexpensive video production equipment by private industry for the production of instructional programs, and the rise of a new industry which engages in the production of packaged instructional programs for this purpose.

Other challenges to universities' roles may arise in the distribution of educational programming via videodisc and videocassette. Neither of these technologies has achieved a substantial consumer market penetration, yet each may enable economical distribution of program materials without dependence on hard-wired connections to the consumer or on real-time course schedules -- a problem to the off-campus student. Videodisc technology in combination with the personal computer can become a very powerful educational technology, permitting complex

branching and routing routines to tailor the sequence of instruction to individual learners' abilities and needs.

Personal computer companies such as Apple and Atari approach the educational market by providing not only the technology but also the software their consumers want. Their style of machine-mediated instruction may eventually rival college level work. Some individuals at the 1983 American Association for Higher Education's annual conference predicted that within twenty years, computers will have replaced the book as the primary delivery device in bringing education to students.

In essence, new information technologies offer innovative ways of packaging the information universities used to be responsible for distributing. The commodity qualities of information are such that the form in which it is used or received constitutes the limits of one's control over it. Universities have been for several centuries the "shopping malls" of knowledge; their libraries and knowledgeable faculty held the information, and their classes and writings distributed it. Now electronic systems can distribute that same knowledge and in fact offer access to more resources than any one university could hope to contain physically. In the face of a competitive supply of information, where will the universities find their market? Will they compete, or will they carve out a new niche for themselves entirely? Lewis Branscomb, (1979) has suggested that universities leave the knowledge distribution function to private or non-university entities and instead concentrate on generating

knowledge.

Producing academic personnel

The university's ability to keep its own personnel, the highly trained academicians and creative scientists, humanists, and engineers, is in great jeopardy. The external market for those same people is hotly competitive. While the undergraduate enrollment in engineering and computer science has been increasing over the last ten years, the number of people continuing to the doctoral level has declined drastically. (Robinson, 1982). People with undergraduate or masters degrees find lucrative employment opportunities and stimulating careers. Unless the university can offer competitive career prospects, its abilities to offer quality education and research experiences -- indeed, its ability to even perform research -- will be in question. The signals from the external marketplace are very apparent: even top engineering schools have trouble recruiting the faculty they need. In essence, the knowledge embodied in personnel has become increasingly subject to commodity forces.

The rapid changes in the technical equipment associated with the most advanced uses of computers and information processing abilities also pose problems for universities with scant resources. Technological obsolescence occurs more easily now than ever before. Machine performance escalates and costs decrease rapidly, but university structures and purchasing abilities cannot equal those in the private sector. Hence,

university researchers are constantly faced with outdated equipment for instruction and research, impairing the ability of faculty to do their jobs, while making other job markets that do not have to contend with resource shortages that much more attractive.

The development of computer-based networks of professionals and databases with topic-specific information can offer a broad variety of capabilities to cadres of specialists: adequate computing power, data and software exchange facilities, and electronic mail, among them. As one NSF representative has commented, "electronic communication resource sharing among scientists will accelerate the tendency of scholars and scientists to identify themselves with their own discipline rather than with their institution. All of the new information technologies are reinforcing this trend as they vanquish distance as a barrier to communication" (Resnikoff, 1981). The university's identity then will necessarily shift. No longer will the academic community be the one that resides on campus. The geographical contiguity of academicians has always resulted in advantageous cross-fertilization; as university faculty seek companionship through databases and computer networks, the university's claim to its community will necessarily have to be redefined. The gains through resource sharing are obviously greater than the resources any one university could hope to obtain; therefore institutions of higher learning may have to rethink ways to create the synergistic effects available through campus collaboration across disparate fields.

Thus, the impact of new information technologies and the heightened value placed on the knowledgeable person (in certain fields) promises to change, if not undercut, the university's ability to sustain its personnel. Private organizations drain away talent with the lure of better research facilities and better pay. The reorientation of faculty toward their disciplines and away from their specific institutions poses challenges to the university's justification for itself as a great meeting place for minds. The sense of membership that faculty and researchers may feel for the institution may be eroded beyond easy repair.

Supplying basic research and new knowledge

New information technologies offer increases in university productivity just as they do in other industries. High speed computers and computer-based networks and developing videodisc technology promise to multiply the academic community's access to information and primary resources: for example, the contents of the Library of Congress stored on videodisc would occupy one wall of an ordinary living room (Resnikoff, 1981). Data and word processing capabilities also speed up analysis and reporting. Yet, is the university community prepared to take advantage of these improvements? Or will it be the case that the same "leveling of skills" effects observed during the industrial revolution occur in the information revolution? No longer will the careful and painstaking researcher whose countless hours in

the library yield the discovery of fugitive data be rewarded for that type of endeavor. Computer databases will magnify the powers of even mediocre researchers. No longer will the skilled statistician be essential in the face of statistical software that can lead even a novice through the proper analyses. Some job displacement within the academic community is to be expected. And quite different skills may define the key research contributions.

While computers may magnify the capabilities of the faculty, increasing its ability to perform research, we must ask whether or not the market the university faces for information pushes research into some directions at the expense of other directions. Will the university's basic research carry sufficient market value to warrant continued support? Will research that has no or only limited immediate market value continue to be performed? The crux of the matter has to do with sources of subsidy and again with a competitive market for information. As one producer of information, the university is beginning to face serious competition from newly arisen private producers of information. Again, distribution systems that efficiently package information -- that packaging contingent on controlling access to and duplication of information -- make its production a commercially viable enterprise. Whereas in the past the distribution of information involved the cumbersome and costly process of transmission through a physical substrate (books, newspapers, people) or the use of scarce, and therefore expensive, electronic channels, the recent proliferation of communication channels, and

the even more dramatic decrease in the costs of information storage and manipulation, have reduced the transmission costs for individual items of information. Since the costs of information production do not increase with the number of consumers of the information, the lowering of distribution costs creates powerful economic incentives for the production of information as an economic commodity. Hence, the university's basic research will be in competition from that produced by other organizations.

The determination of what research receives a subsidy is affected by current economic demands, and research priorities will concentrate on those areas deemed crucial to financial or social payoff. This is no change from trends observed across the industrialization era. It is unlikely, for example, that scientific research will sever its link with the federal government that purchases and underwrites lengthy and large-scale investigations, particularly if they require expensive equipment.

The economic potential intrinsic to basic research also introduces new constraints in the system of peer review and collegial discussion. Gandy (1983) points out: "Many scholars have given up their freedom to discuss their work in exchange for consultant fees; others have their freedom given away for them when their university enters into an exclusive contractual relationship with a commercial firm, or decides to pursue the benefits of the market on its own behalf." Guarded through copyright or patent rights, research findings will receive increased support if they are able to be commoditized. Industry-

sponsored research is more likely to occur if industry interests (eventual commercialization) can be protected. At the annual meeting of the Association of American Medical Colleges, one Johnson & Johnson representative claimed that "patents are a must," explaining that a university researcher supported by his company had published results to avoid being "scooped" by another researcher. The university's internal reward system supports such behavior; nonetheless the company lost the patent that research would have supported, since published information is not appropriable (Focus, March 16, 1983).

Some universities take a different approach, at least for different types of information. Stanford's and the University of California's gene splicing patents are licensed on a non-exclusive bases, on the theory that the university can obtain its return without imposing limitations on the use of information. Indeed, non-exclusive licensing makes sense for some innovations, particularly those which depend on a variety of technologies and patents from different sources for final disposition of a commercial product. Nonetheless, that commercial evaluation must even take place before basic research is undertaken or disseminated bodes a market-driven information supply.

Generating basic research and the funds to support it will therefore become a trickier, negotiated process in the coming years, precisely because information is more than ever a part of our economy and because mechanisms to commoditize it (e.g. patents) are supported.

Supplying applied research

The distinction between basic research and applied research is a tenuous one. Our operational distinction concerns the immediacy of the research activity's goal. If that goal is the solution or understanding of an existing problem, such as in technology or policy, the research is likely to be considered applied. It may or may not have theoretical impact. Allen's (1977) assessment of the link between (basic) science and technology points out the relevance of "gap-filling science." He argues that the "normal path from science to technology is, at best, one that requires a great amount of time" (Allen, 1977, 52). However, in examining the history of certain important technologies, he found that when technology was the source of a problem -- that is, when people could speak in terms of a specific technological need or gap, then science makes a real contribution to technological progress. Technology defines the problem for science; applied research can use scientific theoretical knowledge and provide practical solutions. Such gap-filling science is obviously responsive to technological needs, according to Allen.

The ability of the university to perform such research is contingent upon its own resources, and also on its communication processes with the technologists in possession of the problem and the resources to explore it. Improved databases shared by researchers and technologists can enhance the necessary communication. However, there is also the risk that the applied

research setting, and its lucrative financing, can wield influence on the academic research and teaching priorities. It is no accident that Silicon Valley developed in the shadow of Stanford University, no accident that Boston's Route 128 is near a complex of major universities known for their scientific and engineering programs. One company recently made its location decision in part on the basis of the University of Texas' commitment to upgrading of its computer science program. The applied research market in short can be a quick and dirty source of support for the university. But as the university bends its structure and goals to the demand curve, its autonomy and integrity come into question.

Conclusion

We have argued that the university has been an information producer since its inception, but that its markets and products have altered over the course of history. As primary suppliers of knowledge and information, institutions of higher education have been molded to the needs of society, needs defined by a dominant ideology and economic system. The earliest universities were accountable to their ecclesiastical stakeholders. As education gained its foothold in the democratic ideal, the stakeholder nominally became "society" but realistically was economic interests. While the university traditionally produced the knowledgeable person and its faculty their research, the external market for these products was a sluggish one until

industrialization. That revolution's economy and ideology dictated the need for a population of workers possessing minimal language and mental skills; these workers also had to believe in and desire social mobility. Education's links to the economy were manifest in new curriculum priorities, in the creation of schools transmitting work-related education rather than liberal arts, and in an educational philosophy that acknowledged the importance of socializing people to the routines of industrial production and the joys of consumption.

In recent years, within an economy that values even more highly the type of product (the (technically) educated person, or research) the university produces, and that has found ways to duplicate that product or extend traditional methods of distributing it, the university's traditional role changed. It faces a competitive market, and must "sell" itself more than ever before. As the university's outputs become more subject to market evaluations, its abilities to invest in areas that have limited or no market potential dry up. We already see this in several universities' resource allocation plans: liberal arts areas suffer.

The information society requires workers that are more skilled in certain areas, and it requires ongoing education of those workers. It also has uses for research outcomes. However, industry itself has found ways to control the production of worker commodities by using information technologies and its own internal educators. As other sectors appropriate the

university's functions, the issues of what type of information the university, for whom, and of what quality must be addressed.

If the university's products have been driven by the marketplace in the past, what is the difference if the rein is a little tighter now? As the university's outputs become more subject to evaluations of marketplace desirability, its abilities to invest in areas that have limited or no market potential dry up. The institution prioritizes its knowledge-production activities to facilitate the "packageable," the information that can be most easily commercially exploited via patents, copyrights or other means of control

The net effect may be that such packaging and commercial constraints determine the types of information that are broadly accessible to people and that become most highly valued.

This means that the university's ability to subsidize work which has in the past brought no renumeration, be it public service work or projects or fine arts experiments or humanities programs, lose their importance. Less privileged segments of society may be denied not only information that is most useful to them, but they may also lack access to it as it bears a price.

The demands of the information society intensify trends that have been in place for years. They threaten the knowledge generation and distribution activities that lack commercial impact; they undercut any egalitarian philosophy of sharing information for the good of science of society. The marketplace

ethos also diminishes universities' abilities to subsidize public interests or services or non-market-related products.

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